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HORTICULTURAL EXPERIMENTS AT THE SAN ANTONIO FIELD STATION, SOUTHERN TEXAS.

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INTRODUCTION.

Comparatively little authentic information is accessible regarding the possibilities of fruit culture in the vicinity of San Antonio. Small orchards are found on a few farms here and there, but most of the farmers have little fruit, even for home consumption, and there are no commercial orchards of consequence in the region. Many farmers have planted orchards, but they have become discouraged because of unsatisfactory results, due largely to the selection of varieties not suited to the conditions or to neglect of the trees after planting.

It is not to be expected that commercial orcharding will ever become an important feature of the agriculture of the San Antonio region, but there is no apparent reason why every farmer should not have at least a small orchard to furnish fruit for home consumption. It will be seen from the following pages that the list from which the farmer may select is relatively large.

The greater part of the fruit consumed in the city of San Antonio is shipped in from outside districts. While it is to be expected that the local market will continue to depend upon outside sources, many fruits, such as peaches, grapes, plums, berries, and persimmons, can be produced locally to good advantage and will find ready local sale.

There are a number of factors which have operated to hinder the production of fruit in this section. The climate is characterized by wide extremes of temperature and precipitation, and many failures can be traced directly to climatic causes. The soil is not favorable to the successful growth of some kinds of fruit trees, chiefly because of the excess of lime which it contains, and there are many plant diseases which cause much trouble and damage.[1]

[1] For detailed information regarding the plant diseases of this region, see Heald, F. D., and Wolf, F. A., A plant-disease survey in the vicinity of San Antonio, Texas, U. S. Dept. Agr., Bureau of Plant Industry Bul. 226, 129 p., 19 pl., 1912.

Note.—This bulletin indicates the selections and cultural methods best adapted to successful fruit growing in the vicinity of San Antonio and is of interest to the inhabitants of that region.

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Most fruits mentioned in this paper have been growing under observation for eight years. While this period is too short to permit definite conclusions in every case, it has seemed best to publish the information so far obtained, in order to meet the numerous inquiries received concerning this phase of the work of the San Antonio Field Station.

CLIMATIC CONDITIONS OF THE REGION.

While the winters of San Antonio are mild, the occasional low temperatures prevent the growing of many of the more tender fruits. The severity of the winter climate is not due wholly to the low temperatures, but in a large measure to the suddenness of the changes, which often cause an extremely wide range of temperature in a few hours. Many of the northers which bring the temperature down to a few degrees below freezing are preceded by periods of warm, summerlike weather that start the plants into growth and put them in the worst possible condition to withstand the cold. The minimum temperature does not ordinarily go much below 15° F., as is shown in Table I.

TABLE I.—*Absolute minimum temperatures at San Antonio, Tex., 1892 to 1913, inclusive.*[1]

Year.	Temperature.	Year.	Temperature.	Year.	Temperature.
	°F.		°F.		°F.
1892	19	1900	19	1908	18
1893	26	1901	15	1909	17
1894	16	1902	26	1910	12
1895	11	1903	19	1911	13
1896	27	1904	22	1912	16
1897	18	1905	13	1913	20
1898	20	1906	24		
1899	4	1907	27	Mean minimum.	18

[1] The temperatures for the years 1892 to 1906, inclusive, are taken from the records of the U. S. Weather Bureau, and those for the years 1907 to 1913, inclusive, from the records of the San Antonio Experiment Farm.

The annual rainfall at San Antonio has averaged about 26 inches for the past 20 years. (Fig. 1.) This, if well distributed, should be ample for most fruit trees, and in ordinary seasons should mature a fruit crop, particularly if the trees are planted somewhat farther apart than is now customary and the orchards given good care and culture. In fact, the writers are convinced that the rainfall is not the chief limiting factor in growing such fruits as peaches and plums where the orchard receives proper care, although it must be expected that seasons will occur when the fruit crop will suffer because of insufficient rainfall.

Table II gives the rainfall at the experiment farm for the years 1907 to 1913, inclusive. A comparison of these figures with the

records kept by the Weather Bureau at San Antonio for a much longer period will show that the mean rainfall for the last seven years is slightly below what is to be ordinarily expected. The year 1909, which was the driest that has been known during the observed period (more than 40 years), was followed by two years when the rainfall was considerably below normal. In spite of the adverse conditions during this period, the orchards came through with no loss of trees which could be traced directly to a lack of moisture.

TABLE II.—*Annual precipitation at the San Antonio Experiment Farm, 1907 to 1913, inclusive.*

Year.	Precipitation.	Year.	Precipitation.	Year.	Precipitation.
	Inches.		*Inches.*		*Inches.*
1907	26.68	1910	20.02	1913	36.71
1908	26.27	1911	23.93		
1909	13.14	1912	26.37	Mean	24.66

THE SOIL CONDITIONS.

San Antonio lies in the southern extension of what is known as the Black Prairie region, or the "Black Lands" of Texas, and near the northern edge of an area known geographically as the Rio Grande Plain. The soil is mostly the result of the weathering of limestone rocks of the Upper Cretaceous period. Recent alluvial deposits have been washed down from the higher lands northwest of the city, resulting in modifications through the addition of coarser material. The typical soil is a heavy black or brownish loam.

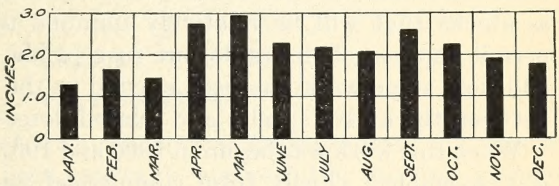

FIG. 1.—The mean monthly rainfall at San Antonio, Tex., from 1891 to 1913. (Compiled from the records of the United States Weather Bureau.)

The lime content of the soil is unusually high, the proportion of carbonate of lime in the upper 12 inches ranging from 7 to 23 per cent. This lime occurs in the soil both as a finely divided material and as gravelly concretions. In the former condition it is generally dark colored through staining by decomposed organic matter, while in the latter condition it is usually white

This excess of lime is believed to be the cause of one of the most serious disorders of fruit trees that have been encountered in the experimental work reported in this paper. The chief symptom is a yellowing of the leaves, and in the later stages the leaves drop and the tree gradually dies. Often in less severe cases the tree may continue to live and make a poor growth and bear some fruit for several years

before it finally succumbs. This disorder or disease is known locally as chlorosis.

Another serious disease which has caused much trouble is root-rot. This disease is believed to be due to a fungus (a species of Ozonium) which lives in the soil and is often more destructive than chlorosis. Some species are particularly susceptible to root-rot, though certain individuals may escape it for some years, probably because of lack of infection.

Crown-gall[1] is a disease that occurs frequently in the San Antonio soils, and there are a large number of species of soil-inhabiting nematodes which are parasitic on the roots of cultivated trees and shrubs.

It is not clear in every case just what causes the disease or death of the plants. It is probable that in many instances there are several causes working together. These causes are, however, located in the soil and separately or together constitute a serious problem, both to fruit production and to experimental work with fruit trees.

SCOPE OF THE EXPERIMENTS.

The horticultural work of this field station has been directed along two major lines: (1) To find which varieties are best adapted to the local conditions and (2) to find what varieties or species can be used as stocks that will be relatively immune to soil troubles and will permit the use of desirable but susceptible varieties as scions. In addition, some work has been started in the way of making hybrids between the native species and related domesticated varieties.

When this work was begun in 1906 and 1907, a collection of varieties was assembled, chiefly from commercial nurseries. This collection has been added to from time to time, and the Office of Foreign Seed and Plant Introduction has placed at the station many new varieties of fruits. In all the tests of varieties, at least two individuals of each kind have been used in the experiment. Sufficient information has been acquired in the tests here reported to prove that a reasonably large list of fruits can be produced by every farmer with which to supply at least his own needs. A number of peach varieties, which ripen from the middle of June to September, have proved adapted to the section. Plums, the most satisfactory fruit of this region, quality and reliability considered, furnish a large list of varieties from which to select, although their ripening season is comparatively short. A fairly large number of varieties of grapes can be grown successfully, although for table use their quality is low. Pears have been grown in the vicinity for a long period and the results observed from the better managed orchards in favored situations indicate that certain

[1] This disease and its causal organism are described in detail in Bureau of Plant Industry Bulletin 213, entitled "Crown-Gall of Plants; Its Cause and Remedy," by Erwin F. Smith, Nellie A. Brown, and C. O. Townsend, issued Feb. 28, 1911.

varieties of pears could be used in the farmer's orchard with the expectation of securing reasonably good results. Persimmons, when worked on resistant stocks, do well and produce fruit nearly every year. Pecans are native here, and while they probably can not be grown successfully on the uplands without an outlay for irrigation that would be prohibitive, they can be grown on the low lands, where there is ground water within reach of the roots. Dewberries should be included in the farmer's garden and by selecting several of the better varieties should prove a valuable addition to the fruit supply for his table.

Owing to the demand made upon the experiment farm for all the information available regarding the possibilities of fruit culture in this section, it has seemed best to include the information available regarding many other fruits which have been tested, but not sufficiently to ascertain how large a part they will play in the fruit production of the region.

In some instances, for example apples and cherries, there is no information at hand that would indicate that they should be added to the farmer's orchards; in fact, the weight of evidence is against them. In the case of other and less common fruits, such as the citrange, there is a lack of information regarding how they will behave under local conditions.

VARIETY TESTS.

PEACH SELECTIONS.

The experimental work with peaches has shown some of the reasons why this crop has not been generally successful in the San Antonio region. Notwithstanding the fact that the trees often grow well, particularly when young, it appears that the standard varieties of the North seldom fruit in this region and are slow to develop flowering buds. They also show other irregularities, such as blossoming in the autumn and early winter, or the blossoms may be delayed until very late in the spring. This lack of adaptability is such as to disqualify many varieties and limit the selection to sorts that do not show these tendencies. With a few exceptions, the varieties of the Persian, North China, and Peen-to races have shown this undesirable new-place effect or for one reason or another have not been productive. On the other hand, varieties of the Spanish and South China races, and especially some of the better seedlings from these varieties, have been found much better adapted to San Antonio conditions. Not all of the varieties of these last two races are satisfactory, however, particularly some of those of the Spanish group. A few of them, particularly of the South China race, are highly susceptible to chlorosis, and some varieties of both races have proved to be shy bearers or to yield inferior or mediocre fruit.

There still remains much to be done in testing these adapted varieties on different stocks. The few experiments made so far indicate that this is a very promising direction for experimentation.

It seems certain that some of the seedlings selected from among the Spanish or Mexican sorts will prove more immune to chlorosis and generally better adapted to the conditions than the seedling stock ordinarily used by nurserymen. The newly introduced Chinese wild peach (*Amygdalus davidiana*) also gives promise of a high degree of immunity to the local soil difficulties. It remains to be shown just

FIG. 2.—A tree of the Honey peach, one of the most reliable for the San Antonio section. This tree is located in the variety-testing orchard in field A–1. Although the trees in this orchard are planted closer together than is desirable for commercial plantings and the orchard has never been irrigated, the trees have made a good growth and some of the varieties have fruited abundantly. (Photographed June 25, 1912.)

how much can be gained by working some of the more desirable but susceptible varieties on these resistant stocks.

In the variety test here reported no special stocks have been used. The trees in the test were purchased from commercial nurseries in Texas and the northern part of Florida and were presumably budded upon the seedling stocks in ordinary use in those nurseries.

In this test the trees of 30 varieties were set in January, 1906, and 5 varieties were set in March of the following year. Two trees of each variety were planted and the orchard has been given thorough, clean cultivation, except for the plowing under of a winter crop of Canada

field peas in the spring of 1912, and again in the spring of 1913. The orchard has never been irrigated, and, although the trees are only 15 feet apart, they have not suffered severely from drought (fig. 2). This test orchard is located in field A–1.[1]

In Table III is given a list of the varieties included in the test, with an indication as to the race to which each variety belongs, where this fact is known. It has seemed best to group them thus, even when it is appreciated that there is a variance of opinion as to where a few of the varieties belong. In the case of crosses it is not always clear in which group to place the variety, and in such instances the predominating race is indicated. Opposite each variety name is given the number of years of fruiting, and the last column indicates the size of the crops. It was found impracticable to give the average yield in pounds, for frequently only a few trees fruited and the injury to the fruit by birds before gathering so reduced the yields that the figures would be of little value and in some instances misleading.

TABLE III.—*Varieties of peaches tested, showing the class to which each belongs, the number of years fruited, and the character of the crop, San Antonio Experiment Farm, 1906 to 1913, inclusive.*

Variety.	Race.	Fruited.		Variety.	Race.	Fruited.	
		Years.	Size of crop.			Years.	Size of crop.
Angel	Peen-to	2	Fair.	Jewell	Peen-to		
Late Bidwell	do			Japanese Dwarf		2	Poor.
Early Bidwell	do			La Reine	Spanish	1	Good.
Chilow	North China			Maggie	Peen-to		
Climax	South China	5	Good.	Oviedo	South China	2	Do.
Cabler	Spanish	2	Fair.	Pallas	do	5	Do.
Countess	Spanish×Persian.	1	Poor.	Peen-to	Peen-to		
				Powers	Spanish	1	Fair.
Colon	South China	3	Fair to good.	Reeves Orange	do		
				Ceylon			
Dorothy	Peen-to			Rivers	Persian	1	Do.
Estella	Spanish	2	Poor.	Suber	Peen-to	1	Poor.
Everbearing	do	2	Do.	Taber	South China	4	Fair to good.
Florida Gem	South China	4	Good.				
Florida Crawford	Spanish			Triana	do	4	Good.
Gibbon	do			Onderdonk	Spanish	1	Poor.
Hall Yellow	Peen-to	1	Fair.	Victor	North China × Spanish.		
Honey	South China	4	Good.				
Imperial	do	5	Do.	Waldo	South China		
Indian Cling	Spanish (?)	1	Poor.				

Table III shows that the varieties of the South China races have so far given the best results. The Pallas, Honey, Imperial, Climax, Florida Gem, and Triana varieties, all belonging to the South China race, are rated as the best, and their performance has been in the order in which they are here named. These results should not be taken as final. Further investigations may develop other and more valuable varieties, and, as already stated, it may be found that the use of other

[1] For a map of the San Antonio Field Station, showing the location of this orchard, see Bureau of Plant Industry Circular 34, "The Work of the San Antonio Experiment Farm in 1908," by F. B. Headley and S. H. Hastings, issued July 22, 1909.

stocks may make it possible to adopt more desirable varieties than those named. All of these South China peaches are small, delicate, and thin skinned, and consequently their use is limited to home consumption or to local markets.

Aside from these definite limitations as to varieties, the production of peaches in the San Antonio region is subject to much the same vicissitudes of climate as in any other peach-producing section. Yet with good cultivation and particularly if the trees are planted well apart, the use of a green-manure crop occasionally appears to be all that is needed to maintain the fertility of the soil, and the various insect pests and fungous diseases of the branches, leaves, and fruits are subject to control by proper spraying.

The net result of this test of peach varieties is to demonstrate the entire practicability of producing on every farm an abundant supply of fruit of excellent quality for home and local consumption. As is shown later (Table IV), these varieties ripen during a fairly long period, beginning in the latter part of June and extending through July and August. Furthermore, if it is desired, the peach season may be materially lengthened by the use of other varieties, which, though possibly somewhat less certain or less prolific, are still worth planting.

SEEDLING PEACHES FROM MEXICO.

In addition to the collection of named varieties already discussed, a seedling orchard,[1] originally of about 500 peach trees, has been grown and fruited with a view to the selection of varieties particularly adapted to local conditions. (Fig. 3.) It was also hoped that this orchard might yield seedlings better suited as stocks for budding with named varieties than the stocks generally used by nurserymen.

These seedlings have shown great diversity as regards vigor, adaptability to local conditions, productiveness, time of ripening, and quality of fruit. After having been fruited for four years, this orchard shows at least 10 trees worthy of description, propagation, and further study. The following trees, with descriptions, all but one of which have been given Seed and Plant Introduction numbers, are undoubtedly the best:

(1) Distributed under S. P. I. No. 32372, classification, South China; fruit, medium size, elliptical, unequal; cavity, large, regular, deep, with abrupt slope; suture, long and deep; apex, long, crooked, pointed, and fleshy; color, pale green, blushed with red; skin, medium thin and tender; flavor, sweet; quality, very good; freestone; ripens the latter part of June; tree vigorous and a good bearer.

[1] The seed from which these trees were produced was collected in Mexico by Mr. Gilbert Onderdonk under the direction of the Office of Foreign Seed and Plant Introduction. They are listed under S. P. I. Nos. 9320 and 9321. For the early history of this orchard see Bureau of Plant Industry Circular 34, entitled "The Work of the San Antonio Experiment Farm in 1908," by F. B. Headley and S. H. Hastings, issued July 22, 1909.

(2) Distributed under S. P. I. No. 32373; classification, South China; fruit, medium size, ovate, and unequal; cavity, medium size, deep, narrow, and abrupt; suture, long and very deep; apex, long, fleshy, and pointed; color, pale green, blushed with red; down, light; skin, thick and tough; flesh, pear white, red at seed, firm, fine, and juicy; flavor, very sweet and very good; freestone; ripens between the middle and the last of August; tree vigorous and a good bearer.

(3) Distributed under S. P. I. No. 32374; classification, Spanish; fruit, medium size, ovate; cavity, large, deep, broad, and slope gradual; suture, deep, very deep at cavity; apex, long and pointed; color, bright greenish yellow; down, medium; skin, thick and tough; flesh, orange yellow, juicy, and firm; flavor, mild, subacid, and very good; cling; ripens between the middle and the last of August; tree very vigorous and a heavy bearer.

(4) Distributed under S. P. I. 32375; classification, Spanish; fruit, round to oblate, but pointed and medium size; cavity, large, broad, deep, and flaring; suture, shallow, but deep at cavity; apex, long, fleshy, and pointed; color, pale whitish yellow; down, light; skin, medium thick and tough; flesh, pale greenish white, medium fine, firm,

FIG. 3.—The Mexican seedling peach orchard. This orchard of originally 265 trees has produced a few trees that may prove to be of value. (Photographed in the spring of 1910.)

and juicy, subacid, good to very good; cling; ripens about the middle of August; tree very vigorous and a medium heavy bearer.

(5) Distributed under S. P. I. No. 32376; classification, South China × Spanish; fruit, medium size; cavity, large, broad, deep, and slope gradual; suture, medium, very deep at cavity; apex, long and pointed; color, greenish white; down, heavy; skin, thick and tough; flesh, greenish white, tender, medium juicy, subacid, and quality good; freestone; ripens from the first to the middle of August; tree fairly vigorous and a medium heavy bearer.

(6) Distributed under S. P. I. No. 32377; classification, Spanish; fruit, medium to large, round, and pointed; cavity, large, broad, deep, and flaring; suture, deep, very deep at cavity; apex, short and pointed; color, greenish white; down, heavy; skin, medium thick and tough; flesh, pale greenish white, slightly tinted, pink at apex of seed, firm, juicy, mild, subacid, and quality good; cling; ripens early in September; tree vigorous and a heavy bearer.

(7) Distributed under S. P. I. No. 32378; classification, Spanish; fruit, ovate, medium to large; cavity, large, very broad, deep, and flaring; suture, medium deep;

apex, short and pointed; color, greenish yellow; down, medium; skin, thick and tough; flesh, deep yellow, firm, medium tender, juicy, subacid, and medium to good quality; cling; ripens early in September; tree medium vigorous and a medium bearer.

(8) Distributed under S. P. I. No. 32379; classification, South China; fruit, elliptical, unequal, medium size to small; suture, medium deep; apex, long, fleshy, and pointed; color, pale green, tinted with red; down, medium; flesh, greenish white, tender and juicy, mild, subacid to sweet, and quality good; freestone; ripens from the middle to the last of July; tree vigorous and a good bearer.

(9) Distributed under S. P. I. No. 32380; classification, South China; fruit, medium small; cavity, medium size and medium depth; suture, medium deep; color, pale green; down, medium; skin, thick and tough; flesh, greenish white, tender, firm, juicy, sweet, and quality good; freestone; ripens during first half of August; tree very vigorous and a medium heavy bearer.

(10) Designated as D23; classification, Spanish; fruit, ovate, pointed, and medium in size; cavity, broad, shallow, and flaring; suture, medium deep; apex, medium long and pointed; color, greenish white; down, medium; skin, medium thick, tough; flesh, greenish white, tender, juicy, subacid, and quality poor; freestone; ripens between September 1 and 15; tree vigorous and a rather shy bearer.

As will be observed from the descriptions, several desirable peaches of the South China type, or at least showing a predominance of this strain, were produced. In quality and flavor they resemble very closely the Honey peach and are valuable as new varieties because by their different periods of ripening they permit the extension of the season of this class of peaches.

Table IV gives the average ripening dates, as shown by the 3 years' record, of the named varieties of the South China group on trial in the variety orchard, together with those that might be added from the Mexican seedling orchard.

TABLE IV.—*Average ripening dates of South China peaches and added seedling varieties at the San Antonio Experiment Farm.*

Variety.	Source.	Ripens.	Variety.	Source.	Ripens.
S. P. I. No. 32372	Mexican seedling	June 26	S. P. I. No. 32379	Mexican seedling	July 24
Honey	Variety orchard	July 4	Florida Gem	Variety orchard	July 30
Triana	do	July 8	S. P. I. No. 32376	Mexican seedling	Aug. 6
Taber	do	July 15	Climax	Variety orchard	Aug. 8
Pallas	do	July 17	S. P. I. No. 32380	Mexican seedling	Aug. 13
Imperial	do	Do.	S. P. I. No. 32373	do	Aug. 21

It will be observed from this table that even by limiting the selection to those of the South China race, the peach season may be extended to cover nearly two months, while by the addition of the Early China, which, according to Mr. Gilbert Onderdonk, ripens about a week or ten days earlier than the earliest of those listed in the table, the season may be extended still farther. By the additional use of some of the late ripening varieties of the Spanish race a still longer season may be secured.

There is a striking difference in the resistance to chlorosis of the different races of peaches. It is particularly noticeable that the seed-

lings of the South China type in the Mexican peach orchard are very susceptible to this disease, while those of the Spanish group are much more resistant. It should be noted in connection with these new varieties of the Spanish race that they are much more prolific than any grown in the test orchard except those of the Honey type. In fact, they are so far superior in production that it is doubtful whether a grower can afford to plant any of the older varieties mentioned rather than the new seedlings, even if the latter should prove to be slightly inferior as to quality. Furthermore, as the better varieties of the Spanish group are much more satisfactory to ship because of their large size, thicker skin, and firmer flesh, they may prove to be better suited to commercial production, though the fruit is distinctly more acid than that from the South China varieties.

PLUM.

Of all the fruits tried at the experiment farm, the plum is the most reliable producer and appears to be the best adapted to San Antonio conditions. The trees flower somewhat later than peach trees and consequently escape much of the late frost injury. Table V shows the varieties that have been under trial sufficiently long to justify tabulating. Of these, 12 varieties were set out in the spring of 1906, and the remaining 4 in the following spring.

TABLE V.—*Varieties of plums tested, showing the class to which each belongs, the number of years fruited, and the character of the crop, San Antonio Experiment Farm, 1906 to 1913, inclusive.*

Variety.	Class.	Origin.[1]	Fruited.	
			Years.	Size of crop.
Abundance	Japanese	Prunus triflora	3	Good.
Bartlett	Hybrid	Prunus triflora×Prunus simonii	3	Fair.
Burbank	Japanese	Prunus triflora	3	Good.
Eagle (*Beauty*)	American	Prunus angustifolia	4	Fair to good.
El Paso	do	do	4	Good.
Excelsior	Hybrid	Prunus triflora×Prunus munsoniana	3	Fair.
Golden Beauty	American	Prunus hortulana	3	Do.
Gonzales	Hybrid	Prunus triflora×chance seedling	5	Good.
Indian Chief	American	Prunus munsoniana	4	Do.
Lone Star	do	Prunus angustifolia	2	Poor.
McCartney	do	do	4	Good.
Pottawattamie	do	Prunus munsoniana	2	Poor.
Terrell	Hybrid	Prunus triflora×(?)	4	Fair to good.
Transparent (yellow)	American	Prunus angustifolia	4	Do.
Wickson	Hybrid	Prunus triflora×Prunus simonii	3	Do.
Wooten	American	Prunus munsoniana	2	Fair.

[1] The origin of the plums was obtained from "Plums of New York," by U. P. Hedrick, assisted by R. Wellington, O. M. Taylor, W. H. Alderman, and M. J. Dorsey.

The most successful plums in the test, orchard quality and productivity considered, are the Gonzales, Burbank (fig. 4), Wickson, Eagle, and Terrell varieties. The Transparent and Wooten are American sorts, and, although they yield good fruit for home use, they are not as valuable to the average grower as those of the Japanese class or some of the hybrids.

The Gonzales and Burbank varieties are rather inclined to overbear, often requiring thinning to produce the best fruit. The season of 1913 was unfavorable for plums because of a severe spring frost, which occurred March 17 and killed the fruit of many of the varieties. In spite of this frost the Terrell plum set a fair crop, while the Gonzales made an excellent yield of fruit. As these varieties were in blossom on March 1 and March 5, respectively, it would seem that they are more resistant to the cold than other varieties.

It should be borne in mind that there are several other varieties of the Japanese sorts, as well as of hybrids between them, that are

FIG. 4.—A bearing tree of the Burbank plum. This variety is well adapted to the San Antonio region of Texas, being of good quality and a reliable bearer. (Photographed July 8, 1912.)

not included in the table. As all representatives of these groups that have been tested have proved successful, it is probable that there are still other varieties that will do well. It is very evident that these three groups of plums are adapted to a much wider range of climatic conditions than are the peach varieties that have proved reliable in the San Antonio section.

PEAR.

Little work with pears has been done on the experiment farm, but observations made on neighboring farms, particularly that of G. A. Schattenberg, at Boerne, Tex., form the basis for some conclusions.

Some few plantings of pears have been made in the vicinity of San Antonio and have given varied results. The soils richest in lime, especially those with limestone gravel very near the surface, are not adapted to the culture of pears. The following varieties have been tested: Bartlett, Kieffer, Kruger, Le Conte, Magnolia, Russet, Sand, Smith, Vermont Beauty, and Early Wilder.

From the behavior of these varieties it would appear that the pear is less promising than the peach and the plum. The trees respond vigorously to a slight increase in altitude. Black lands lying north of San Antonio can produce successfully fruit of the Le Conte and Kieffer varieties, the latter being the more successful. Either of these varieties appears to succeed best when worked on Le Conte seedling stock. A recent oriental introduction of wild pear is being tested, which gives promise of exceptional value as a stock for species of Pyrus or Malus grown in this soil.

Pears in this locality are not free from the disease known as pear twig-blight, but climatic conditions are such that the disease is not severely destructive, and many seasons pass without its appearance, even in infected orchards.

Mr. Schattenberg, of Boerne, has been testing pears since 1892 and during the period has grown a large number of varieties. Boerne is located at an elevation of about 1,400 feet, about 700 feet higher than San Antonio, and though the rainfall is somewhat greater the soil is very similar. Mr. Schattenberg believes that from a commercial standpoint the pear is more promising than any other fruit in sections having similar conditions.

As a class the European varieties do not fruit well, and the fruit is of such poor quality that difficulty is found in marketing the crop. There are, however, a few exceptions to this, as, for instance, the Bartlett, Howell, Duchess, and Guyot varieties. The Bartlett and Angouleme develop such awkward shapes and grow so large that they are frequently unmarketable. The Howell, when dwarfed by working on quince root, is a valuable variety. The best of them all, however, is the Guyot.

The oriental hybrids are the best and most reliable. While rather low in quality, they bear regularly and abundantly. Mr. Schattenberg believes that the Kieffer is the best of this group. Besides the Kieffer the other varieties recommended are the Le Conte, Smith, Garber, Katy (of Texas), Golden Russet, and Magnolia, but for profitable commercial orcharding the Kieffer is far superior to all others in quality and as a market pear. The trees of this variety are inclined to overbear, and severe thinning has to be practiced in most seasons.

It is the opinion of Mr. Schattenberg that pear growing in western Texas on a commercial scale is a profitable venture when the under-

taking is backed by experience, provided the right varieties are chosen and care is used in selecting the locality. His 30-acre orchard, 22 years old, with trees planted 20 by 20 feet apart, which is too close, has frequently borne 200 to 250 bushels to the acre, and some individual trees in favorable situations have borne from 8 to 10 bushels to the tree. This orchard doubtless would have done better had it been possible to irrigate during some of the long, dry periods, although it received clean cultivation after reaching the bearing stage.

GRAPE.

Grape growing in the immediate vicinity of San Antonio has been limited to varieties of rather poor quality, which are used largely for the production of wine. The better varieties of table grapes that have been under trial have not survived the adverse soil conditions. Their failure is due largely to root-rot. Chlorosis, which occurs frequently, also indicates that the lime in these soils is in excess of the tolerance of the better varieties of the table grape. The country about San Antonio is rich in species of native grapes which thrive under these conditions. Some of the most successful of the named varieties under trial are those that have resulted from crosses between cultivated varieties and native species. However, there is an extensive area of red sandy-loam soil adjoining the black lands on the south that should produce excellent grapes if root-rot and chlorosis can be avoided or controlled. The following grapes have been tested on the experiment farm: Bell, Berckmans, Brilliant, Champanel, Cloeta, Eden, Flowers, Goethe, Headlight, Lukfata, Mericadel, Mish, Norton, Thomas, Valhallah, Wapanuka, Wise, Xenia, and Gapotum. Most of these have been unable to survive, because of their susceptibility to root-rot and chlorosis. The varieties that have proved best adapted to this region are Valhallah and Lukfata, although the quality of the fruit is not high. Except for home consumption or for the production of wine, no varieties of grapes have been found that are altogether satisfactory.

In this connection it is of interest to show the parentage of the two grapes mentioned above, as given by the late Mr. T. V. Munson in "Foundations of American Grape Culture." Lukfata was obtained by crossing *Vitis champini*, a native Texas species, with Moore. Valhallah is a cross between Elvicand and Brilliant, and Elvicand is a cross between Elvira and *Vitis candicans*, the native mustang grape.

DEWBERRY.

While none of the small fruits, such as berries, have been tested at the experiment station, it seems advisable to mention the dewberry because of its adaptability to this section, being a native of Texas. It appears to be tolerant of a wide range of soil conditions. Mr. T. R.

Dillon, who has been growing dewberries for several years a short distance south of the station, has been successful on soil that is somewhat more sandy than that at the experiment farm. The area devoted to the crop has varied from 5 to 10 acres. Mr. Dillon considers this one of the most profitable fruit crops for this locality. At the present time he has four varieties—Haupt, Austin May, McDonald, and Rogers. Of the four, he considers Austin May the best, with Rogers second. The Rogers is a particularly desirable variety, as it ripens early. There is some danger of late frost injuring the crop, and occasionally the yield is materially decreased because of early flowering.

PERSIMMON.

A collection of 12 budded varieties of the Japanese persimmon was placed in the experimental orchards in 1906 and 1907. These included both the astringent and the nonastringent types, as follows: Astringent—Yemon, Okame, Hachiya, Tsuru, Triumph, Tanenashi, and Costata; nonastringent—Taber's 129, Yedoichi, Hyakume, Taber's 23, and Zengi.

A number of these varieties have done very well, fruiting regularly since reaching bearing age, and some have produced exceptionally heavy yields for small trees. The varieties that have proved the best are the Okame, Tsuru, Taber's 129, Yedoichi, Hachiya, Hyakume, and Zengi. Of these varieties, the trees of Okame and Taber's 129 are the most prolific and vigorous. Other very highly prized varieties have been added to the collection recently, but as yet have not reached the bearing age.

The persimmon is very susceptible to chlorosis, and many of the varieties under trial have been severely injured by this disease. The *Diospyros virginiana*, which has been used generally as a stock for the Japanese sorts, is very susceptible to this disease and should not be used as a stock in this section.

Several recent importations by the Office of Foreign Seed and Plant Introduction that are under trial here promise to be valuable additions to the list, both for fruit production and for stocks. Among them may be mentioned *Diospyros lotus* (S. P. I. 17906), which has been found to be the most resistant to the soil difficulties of any of the different sorts under trial. (See figs. 5 and 6.) The fruit of this tree is very small and is of little value, however.

PECAN.

No other branch of horticultural endeavor in the San Antonio section promises to afford so broad a field for selection and improvement as the nut trees.

Already a large number of recognized varieties are being tested in this part of the State and undoubtedly there are now in the forests

numerous individual trees bearing nuts of sufficient merit and in sufficient quantity to justify their being propagated as new varieties of special promise for this section.

Twelve standard varieties are growing at this station. The original experiment embodied 19 varieties planted in 1909. These are being tested with much care under good dry-farming conditions. Such results as are indicated here, together with wide and varied observations of the natural home of bearing trees and the behavior of comparable plantings in other situations, all indicate that care should be exercised in selecting locations for pecan plantings. Successful tree growth and fruiting should not be expected when the pecan is planted in a soil where underground water is not within reach of the roots. The surface application of water on most of the higher land of this section does not appear to fulfill the needs of the pecan. As the tree approaches bearing age, the roots must penetrate deeply into soil which is drawing water from the underground water table; then the pecan succeeds and grows to be the most stately tree of Texas. The contention advanced by some enthusiasts that since the pecan is native it can be grown under a great variety of conditions is erroneous. It should be borne in mind that the pecan in this part of Texas is distinctly a river-bottom tree and that the mere application of light surface irrigations sufficient for many other trees will not satisfy its needs.

FIG. 5.—A tree of *Diospyros kaki*, or Japanese persimmon, which is nearly dead from chlorosis. This tree has been in its present location for eight seasons. The only persimmons that have been found that are resistant to chlorosis and root-rot are the native *Diospyros texana* and *D. lotus*. Compare with figure 6. (Photographed September 16, 1913.)

THE LESS IMPORTANT FRUITS.

The fruit crops already enumerated are all that the writers are now prepared to recommend for planting in farm orchards or gardens. Not all of them will be found suited to every farm, but it is believed that some of them may be used on each farm, and in most cases all of them may be used if desired.

In addition to the lists of fruits which have been mentioned, many others have been under experiment at the San Antonio Field Station.

FIG. 6.—A tree of *Diospyros lotus*, an importation from China, which is a very promising stock for the Japanese persimmon. These trees appear to be immune to chlorosis and resistant to root-rot. The one here shown has been growing in its present location for seven seasons. Compare with figure 5. (Photographed September 16, 1913.)

Some of them have been found unsuited to local conditions, and the experiments with others have not yet progressed far enough to warrant final conclusions. There is apparently widespread interest in regard to the possibilities of many of these fruits, and requests for information regarding them are frequent and insistent. In order to meet this demand the following notes are included. It should be

understood, however, that the work is still in progress and later results may modify the conclusions here given.

Prune.—Prunes have not been on trial long enough to produce fruit. However, the young trees are vigorous and appear to be well adapted to the conditions, although this does not signify anything of importance. The varieties on trial here are the Italian, Giant, French, Epineuse, Tragedy, and Pond.

Apricot.—The Cluster, Royal, Moorpark, Early Golden, and Onderdonk apricots have been under trial since the spring of 1906. Several favorable seasons have passed since these trees were of a bearing age, but only a few fruits have yet been produced by any of the varieties. To judge by its behavior, this fruit is not adapted to San Antonio conditions, although a few seedling trees in the neighborhood are said to produce fruit regularly but of rather poor quality. Very often the apricot crop is ruined by frost because of its early flowering season.

Cherry.—The list of cherries that could possibly be of value under San Antonio conditions is very small. From the behavior of those tested and those observed elsewhere, the indications are that this fruit is not adapted to this locality. The Advance, Eagle, Napoleon, and a wild cherry from China were set out in the spring of 1911. The Compass (not a cherry in the pomological sense, as it is a cross between the Miner plum and the Dwarf Rocky Mountain cherry) and the Baldwin were set out in the following spring.

Nectarine and plumcot.—Such other drupe fruits as the nectarines and plumcots have been but little tested. The Crosby nectarine set out in March, 1907, has borne only one crop of fruit since it began to bear four years ago, and it behaves much the same as peaches of the unadapted type. A seedling nectarine occurring in the Mexican seedling orchard has made a vigorous tree, but has borne fruit sparingly and has a tendency to very irregular ripening. This nectarine, however, is of fair quality and may prove to be a good variety for some other locality. Its behavior in the seedling orchard as a tree and as to flowering and fruiting habits resembles closely that of the peach varieties not adapted to this section.

Apple.—Apples have been tested only in a small way at the station, but the behavior of other near-by plantings in similar soils has been observed. Very few trees have produced any fruit. Apparently this region is not suited to apple production. Many apples fail to grow into trees, remaining dwarfed and bushy. The only varieties observed that have been partially successful are the earliest sorts.

Citrus fruits.[1]—It is very doubtful whether even the hardy Satsuma orange grown in parts of Texas will thrive as far north as San Antonio

[1] The testing of citrus fruits at this station has been carried on in cooperation with the Office of Crop Physiology and Breeding Investigations, Bureau of Plant Industry.

unless grown in well-protected situations. A number of plantings have been made in this section, but none of the trees has survived. Plantings of other sorts have been made, but the only citrus trees that have proved hardy are certain varieties of citranges. These fruits were originated by crossing the common sweet orange with the hardy trifoliate orange.[1] The following varieties of these citranges have been under trial: Coleman, Cunningham, Morton, Rusk, Rustic, Savage, and Thornton. Of these the Rusk is the only variety that appears to be adapted to these conditions. The others either have died or made a very poor growth. This variety is bearing fruit for the first time this season.

One interesting feature in connection with this group of fruits is that the trees appear to be immune to the root-rot fungus, so fatal to many other fruit trees. Plantings have been made since 1908, but none of the trees has died from this cause so far as it was possible to observe, although several varieties died from other causes.

There is reason to believe that the Rusk citrange may make a good stock on which to work other citrus fruits in parts of Texas where the trifoliate stock is not adapted. This species has not done well at the experiment farm, whereas the Rusk citrange on its own roots has made an excellent growth. In addition to furnishing a useful fruit, the citrange can be used as a hedge, resembling very much the trifoliate orange, and it should be planted here in preference to that species.

Fig.—A collection of several varieties of figs, including the Mission, Magnolia, and others, has been grown without irrigation. The results indicate that the fig can not be grown successfully in this section without irrigation, and even with irrigation it is a doubtful crop because of winterkilling, except in protected situations. The plant is apparently exceptionally free from chlorosis, but is very susceptible to root-rot, and this disease may be a limiting factor in growing this fruit crop on a commercial scale, even under irrigation. While San Antonio is near the northern limit of the zone where the fig can be grown in Texas, because of low winter temperatures, still, when grown in sheltered situations near buildings or other protection, the trees will survive where temperatures fall much lower than those ordinarily experienced in San Antonio. The fig should by all means be included among the fruits produced for home consumption on the farm. It should be grown, if possible, where some protection is afforded and where an occasional irrigation is possible. The Mission and the Magnolia are the two varieties most generally grown in this vicinity, but several other varieties of the Adriatic type seem to be well adapted. The Smyrna type of figs can not be fruited in

[1] Webber, H. J., and Swingle, W. T. New citrus creations of the Department of Agriculture. Yearbook of the Department of Agriculture for 1904, p. 221–240.

this climate, for the reason that the Blastophaga, the insect necessary for the fertilization of the fruit, will probably not endure the winter temperatures.

Walnut.—Another possibility of nut culture is the Persian walnut, which has already made rapid growth when budded or grafted on the native walnut, although the effort to grow it is at present wholly in the experimental stage. A number of grafts and buds have been worked on the native *Juglans nigra*, both at the station and for Mr. F. F. Collins, who has cooperated in this work. While the trees worked have not yet reached the bearing age, still with the exception of the first year, when they were severely frozen back, the Persian walnuts have made an excellent growth on this stock.

Almond.—Although doubtful for fruit production, owing to its early-blooming tendency, the almond makes a vigorous tree. A few nuts of the Nonpareil variety were secured in 1912 from a tree two years from planting.

Pistache.[1]—A rather complete collection of pistache trees, from which the pistache nut of commerce is obtained, is being tested here. None of the trees has fruited yet. Most of the species appear to be unadapted to these conditions, owing largely to their susceptibility to root-rot. Many of the trees have died from this disease.

Pomegranate.[2]—Although not producing a fruit of much commercial importance, pomegranates have proved to be as well adapted to the particular local conditions as any orchard plant tested, being very resistant to the adverse soil conditions fatal to many fruit trees. As ornamentals or for a hedge plant they are very useful, although occasionally there are winters when they will be injured by frost.

A variety test of 12 named varieties is being conducted, and also seedling pomegranates covering half an acre are being fruited with a view to obtain other varieties. A few pomegranate plants in a home garden will not be amiss, for good specimens of the fruit are delicious and refreshing.

The varieties that have been fruited are the Radinar, San Pipetos, Jative, Hermosilla, Papershell, Sweet, Ruby, Dessia, and Subacid. The varieties in this collection that have produced the best fruits are San Pipetos, Jative, and Dessia, while the Radinar, Papershell, and Subacid varieties have matured the heaviest crops. Plants of the San Pipetos and Jative have made the heaviest growth.

Jujube.—The jujube, or Chinese date (*Ziziphus* sp.), is one of the more promising new fruits, and the hardy types appear to be well adapted to San Antonio conditions. Two species, *Ziziphus mauri-*

[1] The testing of pistache trees at this station has been carried on in cooperation with the Office of Crop Physiology and Breeding Investigations, Bureau of Plant Industry.

[2] The testing of pomegranate varieties at this station has been carried on in cooperation with the Office of Alkali and Drought Resistant Plant Investigations, Bureau of Plant Industry.

tiana (S. P. I. 28129) and *Z. oxyphylla* (S. P. I. 28130), are not hardy. Both *Ziziphus sativa* and *Z. jujuba* are perfectly hardy and have made an excellent growth. Many of the better varieties so highly esteemed in China are being assembled at this station. As yet this fruit is more of a novelty than a product of commercial value, but when properly prepared it is considered a delicacy in this country as well as in China.

Quince.—Only one variety of quince has been tested, and it has not made a satisfactory showing. It is very probable that this fruit is out of its zone here.

Olive.—The Chemlaly and Aberkan olives have been grown here for several years, but the climate appears to be too severe for them.

Date.—Although it is probable that the San Antonio climate is entirely too humid for the date to ripen fruit, the seedlings grown are quite hardy, and the tree is valuable as an ornamental. Temperatures of 12° F. have been experienced without killing the plants, although the leaves are generally injured by temperatures below 20° F.

TESTING RESISTANT STOCKS.

One of the most promising and important lines of horticultural investigation at the present time is the determining of stocks resistant to the local soil troubles. Not only is there a great difference in the power of resistance in different species, but there is also a very noticeable difference in the resistance of different varieties of the same species. As an illustration, many of the seedlings of the Spanish race in the Mexican peach orchard are quite immune to chlorosis, while almost invariably those of the South China group are very susceptible. Certain varieties of persimmon are resistant, while others are severely affected.

The richness of the native flora in economic plants, some of which may be utilized as stocks and others for hybridizing experiments, together with those which have been assembled from this country and by the importation of those which have indicated their susceptibility or resistance to soil disorders, forcibly emphasizes the importance of this line of effort. This work has received special attention the past three years. The preliminary results indicate very distinctly not only that many of the better varieties of fruit which are not considered adapted to these conditions may be utilized, but that additional fruits not commonly grown here may be added to the list.

Persimmon.—One of the most interesting new stocks now under test is the native Texas persimmon (*Diospyros texana*). This is being used as a root for both the American and the Japanese persimmon. It has been found very difficult to work other persimmons on this stock, and many previous attempts have resulted in failure where ordinary methods were used. During the spring of 1912 a number of

good unions were made by the inarch-graft method. These are now growing in the experimental orchard. Both the American and the Japanese sorts seem to be growing fairly well on this stock, but the danger feared is that *Diospyros virginiana* and *D. kaki* will both outgrow the root of *D. texana*, or at least that the trees will be dwarfed and checked in growth for this reason. *Diospyros texana* is distributed over a wide stretch of semiarid country in southwestern Texas, where soils are shallow and very calcareous. The tree has never been known to die from root-rot. Its drought resistance is exceptional, but it apparently responds to a more generous supply of moisture.

A recent importation of a wild persimmon from China, *Diospyros lotus* (S. P. I. 17905 to 17907), by the Office of Foreign Seed and Plant Introduction, is extremely promising as a stock. (See figs. 5 and 6.) Five trees set out in the spring of 1907 have made an excellent growth and are quite resistant to the soil difficulties. The behavior of the trees thus far indicates that this species is entirely at home here. It may prove to be as good a stock as the native persimmon because it seems to be quite as resistant to the soil difficulties, and it may prove to be even better because of its more rapid growth.

Pyrus betulaefolia (S. P. I. 21982), a wild pear from China which has been previously referred to, gives indication of being a good stock for pears in this section. The appearance and growth of the trees here indicate that the species is more resistant to those soil difficulties that noticeably affect the pear on its own roots.

Grape.—At this time there are no table grapes of special value that can be grown here on their own roots. The crown grafting of the native mustang grape (*Vitis candicans*) has been successful, although on the uplands this grape does not do as well as some of the cultivated varieties. There may be other native grapes or hybrids between them and the cultivated varieties that will do well for stocks, but of the many tested at this station none has appeared so promising as the variety known as Lukfata. Eight vines of this variety have been under trial for six years, and none of them has shown susceptibility to either root-rot or chlorosis, the two most serious diseases affecting the grape. There is good reason to believe that by the utilization of these resistant stocks the list of grapes adapted to this section may be materially increased, thus giving an entirely new outlook for grape production.

Walnut.—The Persian walnut is not grown in this part of Texas at this time. Repeated trials have been made, which resulted only in failures. This was due undoubtedly to the fact that the walnut was worked on a stock that was not able to survive these soil conditions. Both native species of the walnut, *Juglans nigra* and *J. rupestris*, are proving to be adaptable stocks for the Persian walnut. Experiments in the propagation of the Persian walnut on these

stocks indicate that patch budding and crown grafting are the most successful methods to be employed. Ring budding gives reasonably good results, but with this method more buds are lost after the union has been formed than is the case with patch budding.

A large number of seedlings of the native black walnut (*Juglans nigra*) were grown by Mr. F. F. Collins, and several of these trees have been budded. With the exception of the first year, the winter of 1911–12, when the young growth was frozen back, a good growth has been obtained. A sufficient number are being grown at this time to demonstrate the value of this stock.

Stone fruits.—Native plums are being used experimentally as stocks for stone fruits. The sorts commonly known as Tenehah

FIG. 7.—Two rows of *Amygdalus davidiana*, a peach from China introduced by the Office of Foreign Seed and Plant Introduction, which is a very promising stock for stone fruits. These trees were set out in January, 1909. (Photographed September 16, 1913.)

(*Prunus munsonii*), American (*Prunus americana*), and hog (*Prunus rivularis*) are included in this test. It is not expected that all of these species will be useful on a large scale, but the vigorous growth of the different species under very adverse conditions on the limestone hills about San Antonio proves their hardiness.

A wild peach from China (*Amygdalus davidiana*, S. P. I. 21227), which bears a fruit of no value, has proved to be unusually well adapted to San Antonio conditions. (See fig. 7.) So far it has proved to be resistant to both chlorosis and root-rot. One orchard of about 30 trees, set in January, 1909, has survived without the loss by disease of a single tree. This species is being tested as a stock for peaches, plums, almonds, and apricots. The only serious drawback of this tree so far noted has been its failure to produce

seed. In this respect it behaves in this locality not unlike the unadapted peach varieties.

Trees of the Spanish group in the Mexican seedling peach orchard are relatively resistant to the soil difficulties and give every indication of furnishing a better stock on which to work stone fruits than peaches of the unadapted type. This orchard is now being kept chiefly for the production of such seed, in order to supply desirable stocks for local peach plantings.

SUGGESTIONS ON ORCHARD MANAGEMENT.

Cultivation.—Orchard cultivation of all kinds around San Antonio without irrigation must necessarily be much more intensive than in

FIG. 8.—Orchard cultivator used in the experimental orchards to establish a mulch and keep down weeds. Clean culture is absolutely necessary for successful fruit production in the San Antonio section. (Photographed July 12, 1912.)

more favored sections because of the uneven distribution of the rainfall. Clean culture, especially when the trees have reached the bearing stage, is absolutely essential, for all available moisture must be conserved. As much care must be given the orchard as is given cotton or corn, if successful results are to be obtained. The best method of orchard culture, rigorously practiced at the San Antonio Field Station, is to keep a 3-inch or 4-inch earth mulch on the ground throughout the growing season. After every rain of any consequence, from early spring until fall, the orchards have been gone over, either with an orchard cultivator (fig. 8) or a spike-tooth harrow. If the orchard cultivator is equipped with sweeps to supplement the ordinary shovels and these sweeps are used when the

weeds appear, there will be practically no necessity for hand labor in keeping the orchard free from weeds, except near the trees.

Planting distances.—The distances apart of planting the trees should be greater than is customary in regions of greater rainfall. In the test orchards the trees were spaced 15 to 17 feet apart, but this is much too close for the trees to do well after they reach full size. Peach trees should be not less than 25 feet apart, and a greater distance may be advisable. Plums may be planted somewhat closer together, but it will be found in the end that wide spacing will give more satisfactory results.

Green-manure crops.—The soils of the San Antonio region are often lacking in organic matter. Green-manure crops or stable manure will do much to correct this condition. Cowpeas were first used as a green-manure crop, planted late in July. As that is the season of the year when droughts are most likely to occur, it was found that this crop was not wholly satisfactory. Later, Canada peas were introduced as a winter-cover and green-manure crop. This has proved the best of any so far tried. The Canada peas should be planted as soon after the first of October as possible, or at about the time oats are ordinarily sown. Satisfactory results have been obtained by planting with an ordinary grain drill, seeding at the rate of about 90 pounds per acre. The crop is plowed under the latter part of February or early in March. The best variety so far tested is known as the Golden Vine (S. P. I. 30134). It has been grown here for the past two winters in comparison with several other varieties and is the only one that has survived a temperature as low as 15° F. above zero.

SUMMARY.

There is comparatively little authentic information regarding the possibilities of fruit culture in the vicinity of San Antonio. Consequently, the greater part of the farming population is poorly supplied with fruit.

The horticultural work of the San Antonio Field Station included not only the testing of a large collection of varieties, but tests of resistant stocks have also received much attention.

A number of limiting factors govern fruit production in this region. The soil conditions are unfavorable for many fruits. The climate is too severe for such fruits as oranges and olives and too mild for apples and cherries. The rainfall is sufficient for most fruits if the trees are spaced at somewhat greater distances than in more humid climates.

The early attempts at peach growing were made with seedlings from the early Spanish importations. The later introductions consisted largely of varieties of the North China, Persian, and Peen-to races, none of which has proved wholly successful.

With the introduction af the Honey peach a new type was found which has proved particularly well adapted to the conditions. The

Pallas, Honey, Imperial, and Climax have proved to be the most reliable and promising of the varieties so far tried.

A large number of varieties of the American and Japanese classes of plums do well. The best among the 14 varieties under trial are the Gonzales, Wickson, Burbank, Excelsior, Eagle, and Terrell.

Of the other stone fruits tested, which include cherries, nectarines, and plumcots, it was found that none of the varieties under trial has given good results.

Pears do fairly well on the higher lands. The Kieffer is the best variety for general planting.

Native grapes are abundant in the San Antonio area, and some of the cultivated varieties that are related to these wild species may be grown. None of them, however, possess qualities that justify their use as table grapes.

Of the small fruits, dewberries have been found to return good profits when properly cared for.

None of the citrus fruits has done well, with the exception of the Rusk variety of citrange. This variety is perfectly hardy and has made good growth.

Figs seldom go through the winter without being injured by cold, except in protected locations. The Mission and Magnolia are probably the best varieties.

Persimmons are included among the fruits that do well. The varieties that have given the most satisfactory results are the Okame and Taber's 129.

The native pecan is distinctly a river-bottom tree. When grown where underground water is available it does well, but results on the uplands have been disappointing, even with irrigation.

The Persian walnut does not do well on its own roots, but when worked on either *Juglans rupestris* or *J. nigra* it makes a good growth.

Almonds have a tendency to flower so early that they are injured by frost and rarely fruit.

Pistache trees, while making a vigorous growth, are so susceptible to root-rot that it is doubtful whether they can be grown successfully.

Pomegranates make a vigorous growth and fruit well, but are occasionally injured by cold.

The jujube, or Chinese date, is one of the promising new fruits.

Although the date palm can be grown, the climate is probably not suitable to the production of the fruit.

The cultivation of orchards must be more intensive than where there is a greater rainfall. Clean culture during the summer is absolutely essential.

Canada peas have been found to be the most satisfactory green-manure crop.